

CLAIMS:

[c01] 1. An apparatus for monitoring the performance of a distributed system, said distributed system comprising a plurality of cooperating units disposed in a communications network, wherein said apparatus comprises:

a plurality of diagnostic components, wherein each unit of said system comprises at least one of said diagnostic components, and wherein each diagnostic component further comprises

a. at least one sensor for sensing at least one unit performance characteristic and representing said at least one characteristic as raw data;

b. a data reduction module adapted to receive and process said raw data produced by said at least one sensor to generate reduced data;

c. a transceiver adapted to receive said reduced data from said data reduction module and to transmit and receive said reduced data to and from said plurality of units using said network; and

d. a data analysis module adapted to accept and analyze said reduced data from said transceiver to produce performance data related to said distributed system.

[c02] 2. The apparatus of claim 1, wherein said data analysis module utilizes said performance data to estimate a remaining lifetime of said distributed system.

[c03] 3. The apparatus of claim 1, wherein each said diagnostic component further comprises at least one user interface module adapted to receive said system performance data from said data analysis module for communicating said system performance data of said distributed system to a user.

[c04] 4. The apparatus of claim 1, wherein at least one unit of said plurality of units further comprises a publish/subscribe server (PSS), and wherein said transceiver is adapted to communicate with said PSS to manage data flow on said network.

[c05] 5. The apparatus of claim 1, wherein said plurality of units comprises a plurality of transformers.

[c06] 6. The apparatus of claim 5, wherein the plurality of transformers comprises sensors configured to measure a gas byproduct produced by degradation of transformer winding insulation.

[c07] 7. The apparatus of claim 1, wherein said plurality of units comprises a plurality of components of an engine.

[c08] 8. The apparatus of claim 7, wherein said engine is selected from the group consisting of turbines and internal combustion engines.

[c09] 9. The apparatus of claim 1, wherein said at least one performance characteristic is selected to measure the security of said units.

[c10] 10. The apparatus of claim 9, wherein said units comprise passenger airliners, and wherein said at least one performance characteristic is at least one of altitude, rate of altitude change, position, deviation from flight plan, velocity, and rate of velocity change.

[c11] 11. The apparatus of claim 1, wherein said network comprises a wireless network.

[c12] 12. The apparatus of claim 11 wherein said wireless network is selected from the group consisting of radio waves, wireless LAN's, satellite networks and mobile telecommunications systems.

[c13] 13. The apparatus of claim 11, wherein said wireless network is configured to support communication among at least one active subset of said plurality of units, wherein said active subset comprises a subset of said plurality of units comprising said

distributed system that are actively in cooperation and communication with each other.

[c14] 14. The apparatus of claim 1, wherein said network comprises a wired network.

[c15] 15. The apparatus of claim 14, wherein said wired network is connected by a communications medium selected from the group consisting of metallic wire cables, fiber optic cables and Ethernets.

[c16] 16. The apparatus of claim 1, wherein said network is configured to be accessible via the Internet.

[c17] 17. The apparatus of claim 1, wherein said at least one sensor of said diagnostic component is selected from the group consisting of chemical sensors, biological sensors, electrochemical sensors, mechanical sensors, vibration sensors, stress sensors, thermal sensors, environmental sensors and financial performance sensors.

[c18] 18. The apparatus of claim 1, wherein said data reduction module of said diagnostic component is adapted to process said raw data by at least one statistical technique selected from the group consisting of comparison of said raw data to a predetermined specification value, statistical correlation, trend analysis, regression, calibrations, and multivariate statistical techniques.

[c19] 19. The apparatus of claim 1, wherein said data analysis module of said diagnostic component is adapted to process and interpret said reduced data by at least one statistical technique selected from the group consisting of correlation techniques, multivariate statistical process analysis, and pattern recognition techniques.

[c20] 20. An apparatus for monitoring the performance of a distributed system, said distributed system comprising a plurality of cooperating units disposed in a communications network, wherein said apparatus comprises:

a plurality of diagnostic components, wherein each unit of said system comprises at least one of said diagnostic components, and wherein each diagnostic component further comprises

a. at least one sensor for sensing at least one unit performance characteristic and representing said at least one characteristic as raw data;

b. a data reduction module adapted to receive and process said raw data produced by said at least one sensor to generate reduced data, wherein said raw data is processed by at least one statistical technique selected from the group consisting of comparison of said raw data to a predetermined specification value, statistical correlation, trend analysis, regression, calibrations, and multivariate statistical techniques;

c. a transceiver adapted to receive said reduced data from said data reduction module and to transmit and receive said reduced data to and from said plurality of units using said network;

d. a data analysis module adapted to accept and analyze said reduced data from said transceiver to produce performance data related to said distributed system, wherein said reduced data is analyzed using at least one statistical technique selected from the group consisting of correlation techniques, multivariate statistical process analysis and pattern recognition techniques; and

e. at least one user interface module adapted to receive said system performance data from said data analysis module for communicating said system performance data of said distributed system to a user;

[c21] 21. A method for monitoring the performance of a distributed system comprising a plurality of cooperating units disposed in a communications network, said method comprising:

sensing at least one unit performance characteristic and representing said at least one characteristic as raw data;

processing said raw data to generate reduced data;
transmitting said reduced data to and from said plurality of units using said network; and

analyzing said reduced data to produce performance data related to said distributed system;

wherein each unit comprises at least one diagnostic component configured to perform the steps comprising said method.

[c22] 22. The method of claim 21 further comprising communicating said performance data of said distributed system to a user.

[c23] 23. The method of claim 21, wherein said plurality of units comprises a plurality of transformers.

[c24] 24. The method of claim 23 wherein sensing further comprises measuring a gas byproduct produced by degradation of transformer winding insulation.

[c25] 25. The method of claim 21, wherein said network comprises a wireless network.

[c26] 26. The method of claim 21, wherein processing said raw data comprises using at least one statistical technique selected from the group consisting of comparison of said raw data to a predetermined specification value, statistical correlation, trend analysis, regression, calibrations and multivariate statistical techniques.

[c27] 27. The method of claim 21, wherein analyzing said reduced data comprises processing and interpreting said reduced data using at least one statistical technique selected from the group consisting of correlation techniques, multivariate statistical process analysis, and pattern recognition techniques.

[c28] 28. An apparatus for monitoring the performance of a distributed system, said distributed system comprising a plurality of cooperating units disposed in a communications network, wherein said apparatus comprises:

a plurality of diagnostic components, wherein each unit of said system comprises at least one of said diagnostic components, and wherein each diagnostic component further comprises

a. at least one sensor for sensing at least one unit performance characteristic and representing said at least one characteristic as raw data, wherein said at least one performance characteristic is selected to measure the security of said units.

b. a data reduction module adapted to receive and process said raw data produced by said at least one sensor to generate reduced data;

c. a transceiver adapted to receive said reduced data from said data reduction module and to transmit and receive said reduced data to and from said plurality of units using said network; and

d. a data analysis module adapted to accept and analyze said reduced data from said transceiver to produce performance data related to said distributed system, wherein the data analysis module utilizes said performance data in a pattern recognition technique to discern a potential security threat related to said units.

[c29] 29. The apparatus of claim 28, wherein said plurality of cooperating units comprise passenger airliners, and wherein said at least one performance characteristic is at least one of altitude, rate of altitude change, position, deviation from flight plan, velocity and rate of velocity change.

[c30] 30. The apparatus of claim 28, wherein said distributed system comprises a plurality of security systems monitoring the security of an area, and wherein said performance characteristic is at least one of open door sensor status signals, fire sensor signals, water pressure sensor signals, structural displacement signals,

personnel inspection alert signals, baggage inspection alert signals, and security personnel alert signals.